

## Nokia 7950 Extensible Routing System

### Expandable Media Adapters

Nokia Expandable Media Adapters (XMA) provide cost-efficient Gigabit Ethernet, 10GE, 40GE, 100GE and 400GE interface options for the 7950 XRS family that support the full range of functional requirements for IP routing, Multiprotocol Label Switching (MPLS), internet peering, infrastructure services and IP/optical integration.

Nokia's industry-leading 2.4 Tb/s FP4 network processor powers a new generation of XMA with ultra-high density, 100GE QSFP28 and 400G CFP8 port configurations, with flexible breakout options for 10GE and 40GE interfaces. More granular scaling requirements and additional interface options are addressed by the 200G (full duplex) Compact XMA (C-XMAs) and 400G (full duplex) that are powered by FP3 silicon.

All XMA variants can be equipped in any platform of the 7950 XRS family. A flexible software licensing scheme allows for customizing the XMA for diverse core router tasks such as provider routing, Border Gateway Protocol (BGP) peering, MPLS switching, and Layer 2/Layer 3 virtual private network (VPN) infrastructure services, with configurable quality of service (QoS) granularity.

The versatility and flexibility provided by the 7950 XRS Media Adapters enables operators to consolidate core routing systems on a common platform, to protect hardware investments over time and to rapidly respond to evolving requirements with minimal impact and capital outlay.

36/72-port GE SFP/CSFP Compact XMA



20-port 10GE SFP+ Compact XMA



2-port 100GE CFP Compact XMA



40-port 10GE SFP+ XMA



4-port 100GE CXP XMA



4-port 100GE CFP2 XMA



2-port 100G DWDM XMA



24-port 100G universal QSFP28 XMA



6-port 400G CFP8 XMA



Each XMA contains one or two FP-based forwarding complexes that perform functions such as packet lookups, traffic classification, processing and forwarding, service enablement and QoS. Each XMA also provides specific interface ports, physical media and optical functions. XMAs are equipped in an XRS Control Module (XCM), which contains a slot-level control plane subsystem with a dedicated multicore CPU and 4G DDR3 memory, and the fabric interface based on two T-chips to interconnect to the system switching fabric modules (SFM).

Each XCM can host two XMAs or C- XMAs. The 7950 XRS -20 and 20e each use dedicated XCM variants, and can equip a total of 10 XCMs per chassis. The XCM variants powered by the T3 chip offer 800G full duplex aggregate slot capacity to a pair of FP3 XMAs or C-XMAs. XCM2 variants powered by the T4 chip support FP4 XMAs, and require switching fabric modules based on the S4 chip (SFM2). The XCM2 variant for the XRS-20 offers 3.2 Tb/s full

duplex aggregate slot capacity, and the XRS-20e variant offers 4.8 Tb/s. SFM2 supports both XCM and XCM2 and is common for the 7950 XRS-20 and 20e. The Control Processor Modules (CPMs) are common as well, and support both FP3 and FP4 system configurations.

The XMA-XCM concept (see Table 1) enables exceptional modularity and investment protection by decoupling the forwarding logic from control and switching logic. It allows network operators to mix FP4 XMAs, FP3 XMAs and C-XMAs in a single chassis, and provides the flexibility to upgrade to higher system slot capacity without having to replace existing XMAs. The XCM concept also gives a cost-efficient option to pre-equip XMAs by only powering those that are providing services. Distributing certain control plane capabilities on the XCMs also improves control plane scalability and in-service hardware upgrade performance.

Figure 1. XMA-XCM modular hardware architecture

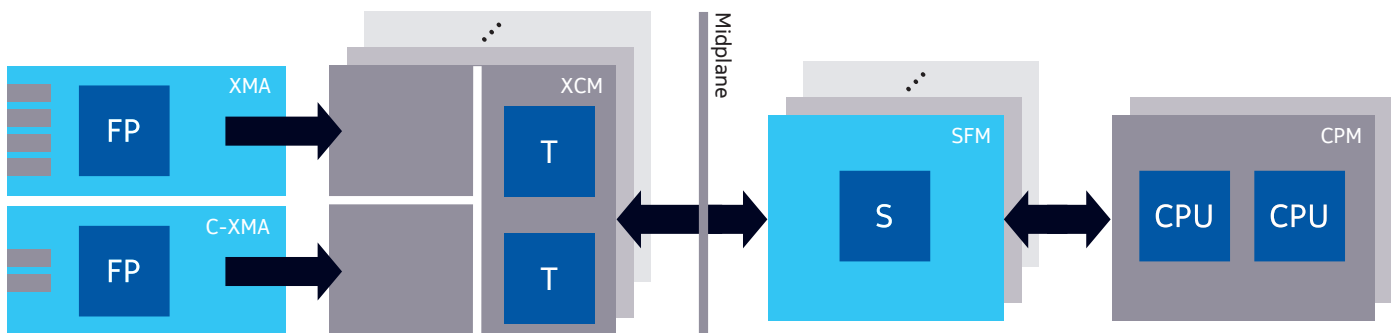


Table 1. Hardware combinations and system configurations

XRS media adapters (C-XMA, XMA)	XMA Control Modules (XCM)	Switch Fabric Modules (SFM)	Control Processor Modules (CPM)
Forwarding complex and port interfaces	Slot-level control and memory	Switching fabric	System-level control, routing and processing
200G C-XMA (1xFP3) or 400G XMA (2xFP3)	XCM-20 (800G FD), 10 per XRS-20	SFM (7+1 redundancy)	CPM (1:1 redundancy)
200G C-XMA (1xFP3) or 400G XMA (2xFP3)	XCM-20e (800G FD), 10 per XRS-20e	SFM (7+1 redundancy)	CPM (1:1 redundancy)
2.4T XMA (2xFP4)	XCM2-20 (3.2T FD), 10 per XRS-20	SFM2 (7+1 redundancy)	CPM (1:1 redundancy)
2.4T XMA (2xFP4)	XCM2-20e (4.8T FD), 10 per XRS-20e	SFM2 (7+1 redundancy)	CPM (1:1 redundancy)

## Features and benefits

### Optimize capacity and flexibility

Traditional core routers deploy custom ASICs that optimize forwarding capacity and port density but often trade off service capabilities, which reduces deployment flexibility and versatility. The Nokia 7950 XRS rejects compromises and avoid dilemmas by leveraging programmable 2.4 Tb/s network processing silicon—the Nokia FP4 chipset. State-of-the-art 16nm 2.5/3D FinFETPlus technology enables FP4 to deliver 6 times the scale and twice the efficiency of FP3. And it adds enhanced packet intelligence and control capabilities to support emerging requirements for dynamic flow optimization, network slicing and distributed denial of service (DDoS) mitigation for cloud, 5G and Internet of Things applications.

As a result, the XRS platform combines tremendous forwarding performance with unprecedented hardware flexibility. Where alternative core routers have to resort to multiple line card variants and additional platforms to cover the spectrum of core routing needs, the 7950 XRS can bring it all on one platform with common hardware and excellent investment protection.

Line card licenses allow for tailoring and tuning the 7950 XRS system to customers' evolving needs. MPLS, IP core routing, advanced BGP peering, VPN service, virtual private LAN service (VPLS) and advanced QoS and security capabilities can be unlocked through a simple license upgrade, without hardware changes or maintenance windows.

Whether deployed in the metro core, in the IP backbone, as a data center gateway or an internet peering point, the 7950 XRS will meet your networking needs.

### Performance and resource efficiency

The FP4 chipset offers deterministic packet forwarding performance under full load, even when complex packet lookup and advanced traffic management operations are required. The P4

chip performs packet processing and integrates intelligent lookup memory to optimize packet lookup operations, and traffic management is performed separately by the Q4 chip. This approach gives the flexibility to optimize line cards designs for different queuing and scheduling requirements.

The 2.4 Tb/s FP4 chipset enables line card designs with an optimal geometry for 100GE and 400GE interfaces at full rate, and pave the way to supporting terabit-rate clear channel interfaces.

Smart, 2.4 Tb/s silicon also helps to reduce the number of hardware components. XMA modules share two FP4 complexes and are able to drive 24 QSPF28 ports at 100 Gb/s rates or 6 CFP8 ports at 400 Gb/s rates. Conversely, competing line card designs with lower speed silicon typically replicate memory for each forwarding complex in separate hardware slices, demonstrate choppy forwarding performance with limited traffic management, and are unable to support 1TE interfaces in future.

### Innovation to rely on

While the Nokia 7950 XRS is a highly innovative platform, it leverages field-proven and time-tested technology. The FP3 and FP4 network processors that power the 7950 XRS interface cards also drive the line cards of the Nokia 7750 Service Router (SR) platform. Currently in its fourth generation, FP routing silicon has evolved in a mature and field-proven technology.

The FP4 chipset enables the 7950 XRS to run the same Nokia Service Router Operating System (SR OS) used in the 7750 Service Routing family, and leverage over a decade of software innovation, field validation and maintenance. Groundbreaking reliability features such as non-stop routing and services were first introduced in the SR OS and set new industry standards on availability.

Operators familiar with the SR OS will find qualification and operational integration of the 7950 XRS effortless. The Nokia Network Services Platform (NSP) enables operators to minimize operational costs and complexity with a converged

and consistent management and Carrier SDN WAN solution that spans the entire routing portfolio and select products in optical transport, access and wireless.

## Leading performance

- Universal 100GE QSFP28 ports with ultra-high density 10x10GE and 2x40GE breakout options with support for SR and LR optics
- High-density 400G clear channel interfaces with CFP8 ports
- XMA's are usable across all XRS platform variants to optimize investments and sparing
- Pluggable optics with Digital Diagnostic Monitoring (DDM) for extended operations, administration, and maintenance (OAM) support
- Integrated 100G coherent PM-QPSK tunable DWDM interfaces with OTU4 framing and staircase EFEC to enable multivendor interoperability

## Rich capabilities

- Flexible, tiered feature licensing model to pay for only the functionality required, and in-place feature upgrades without changing the hardware
- Scalable IPv4/IPv6 unicast routing (BGP, Open Shortest Path First (OSPF), and Intermediate System-to-Intermediate System (IS-IS) with traffic engineering extensions) covering all-IP core needs

- Scalable IPv4/IPv6 multicast routing (PIM, MSDP)
- MPLS label edge router (LER) and label switch router (LSR)
- Multi-instance IS-IS and OSPF segment routing support
- Layer 2 and Layer 3 virtual leased line (VLL) and VPN services
- Configurable QoS granularity from 8 ingress and 8 egress to 128,000 ingress and 128,000 egress queues per port

## Seamless operation

- Runs same SR OS binary for reliable, seamless and consistent performance
- Extensive OAM tool set, which provides tightly integrated visibility, management and control of the platform, network and services
- WAN and LAN PHY support options for 10GE cards
- Hot-replaceable
- Multivendor SDN control integration through OpenFlow and NETCONF/YANG support
- Service automation and cross-layer network management through the Nokia NSP

# Technical specifications

Table 2. FP3 port densities\*

Card type	Interface type	Maximum port density		
		XRS-40	XRS-20e	XRS-20
36/72 x GE C-XMA	GE Small Form Factor Pluggable Optics (SFP/CSFP)	1440/2880	720/1440	720/1440
2x100GE C-XMA	100GE Small Form Factor Pluggable Optics (CFP)	80	40	40
6x40GE C-XMA	40GE Quad Small Form Factor Pluggable Optics (QSFP+)	240	120	120
20x10GE C-XMA	10GE Small Form Factor Pluggable Optics Plus (SFP+)	800	400	400
4x100GE XMA	100GE Small Form Factor Pluggable Optics (CXP, CFP2)	160	80	80
40x10GE XMA	10GE Small Form Factor Pluggable Optics Plus (SFP+)	1,600	800	800
2x100G DWDM XMA	LC fiber connector (PM-QPSK tunable with OTU4 framing)	80	40	40

\*Specifications listed are hardware capabilities. Some capabilities depend on support in a specific SR OS release or future release.

Table 3. FP4 port densities\*\*

Card type	Interface type	XRS-20e	XRS-20
24x100G QSFP28 universal XMA	100GE Quad Small Form Factor Pluggable (QSFP28)	480	320
	40GE QSFP28 (2x40GE breakout with LR or SR optics)	960	640
	40GE QSFP+ (1x40G breakout with LR4, SR4 and ER4 optics)	480	480
	10GE QSFP28 (10x10G breakout with LR or SR optics)	4,800	3,200
	10GE QSFP+ (4x10GE LR with MTP breakout)	1,920	1,920
6 x 400G CFP8 clear channel XMA	400G Small Form Factor Pluggable Optics (CFP8)	120	80

\*\* Specifications listed are hardware capabilities. Some capabilities depend on support in a specific SR OS release or future release.

## Physical dimensions

### C-XMAs (200G)

- Height: 314.2 mm (12.37 in)
- Width: 42.9 mm (1.69 in)
- Depth: 460.7 mm (18.14 in)
- Weight: 5.3 kg (11.6 lb)

### XMAs (400G)

- Height: 392.4 mm (15.45 in)
- Width: 42.9 mm (1.69 in)
- Depth: 460.7 mm (18.14 in)
- Weight: 7.7 kg (16.7 lbs)

### XMAs (2.4T)

- Height: 392.4 mm (15.45 in)
- Width: 42.9 mm (1.69 in)
- Depth: 460.7 mm (18.14 in)
- Weight: 7.8 kg (17.2 lb)

## 10GBASE LAN and WAN PHY

- LAN and WAN PHY support options for 10GE cards

## QoS support

Configurable through software licenses from 8 ingress and 8 egress queues per port to a total of:

- 128,000 shared queues per C-XMA
- 256,000 shared queues per FP3 XMA
- 512,000 shared queues per FP4 XMA

## MAC address capacity

- IP core:
  - Up to 128,000 media access control (MAC) forwarding information base (FIB) entries per C-XMA/XMA
- Higher scale enabled through additional licenses

## IP FIB capacity

- LSR license: 64,000 FIB entries (IPv4 + IPv6)
- IP core license: 1 million FIB entries (IPv4 + IPv6)
- Higher scale enabled through additional licenses

## Feature and protocol support highlights

Feature and protocol support within the 7950 XRS family includes, but is not limited to, the following:

### IP and MPLS routing features

- IP unicast routing: Routing Information Protocol (RIP), IS-IS, OSPF, Multiprotocol Border Gateway Protocol (MBGP), Unicast Reverse Path Forwarding (uRPF), comprehensive control plane protection features for security, and IPv4 and IPv6 feature parity
- IP multicast routing: Internet Group Management Protocol (IGMP), Multicast Listener Discovery (MLD), Protocol Independent Multicast (PIM), Multicast Source Discovery Protocol (MSDP), and IPv4 and IPv6 feature parity
- MPLS: Label edge router (LER) and label switch router (LSR) functions with support for seamless MPLS designs, MPLS-Transport Profile (MPLS-TP), Label Distribution Protocol (LDP) and Resource

Reservation Protocol (RSVP) for MPLS signaling and traffic engineering, Point-to-Point (P2P) and Point-to-Multipoint (P2MP) label switched paths (LSPs) with Multicast LDP (MLDP), P2MP RSVP and weighted Equal-Cost Multi-Path (ECMP)

## Segment routing and SDN features

- Multiple instance IS-IS and OSPF Segment Routing support with shortest path tunnel, Segment Routing Traffic Engineering (SR-TE) LSP, and static and BGP SR policy. The implementation provides LFA, remote LFA and Topology-Independent LFA (TI-LFA) protection for all types of tunnels. PCEP allows the delegation of the SR-TE LSP to the Nokia NSP or a third-party PCE function.
- Programmable forwarding tables via gRPC-based RIB API feature and MPLS forwarding policy
- Extensive set of capabilities using access control list (ACL) logic to steer routes/flows toward various target types, such as IP next-hop SR-TE/RSVP-TE LSP/MPLS-TP and virtual routing and forwarding (VRF), and in a wide range of routing and service contexts such as Global Routing table, Virtual Private Routed Network (VPRN), Virtual Private LAN Service (VPLS) and Epipe service; supports control interfaces such as OpenFlow, FlowSpec, CLI and NETCONF
- Multivendor SDN control integration through OpenFlow, PCEP, BGP-LS and BGP SR Policy support

## Layer 2 features

- Ethernet LAN (ELAN): BGP-VPLS (Virtual Private LAN Service), Provider Backbone Bridging for VPLS (PBB-VPLS), Ethernet VPN (EVPN) and PBB-EVPN
- E-Line: BGP-VPWS (Virtual Private Wire Service), EVPN-VPWS and PBB-EVPN
- E-Tree: EVPN and PBB-EVPN
- EVPN: EVPN-VXLAN (Virtual eXtensible LAN) to VPLS/EVPN-MPLS gateway functions
- E-Tree: EVPN and PBB

## Layer 3 features

- IP-VPN, enhanced internet services, EVPN for Layer 3 services with integrated routing and bridging (EVPN-IRB), and Multicast VPN (MVPN), which includes Inter-AS MVPN and Next Generation MVPN (NG-MVPN)

## System features

- Ethernet satellites: Port expansion through local or remote Nokia 7210 SAS-S series GE, 10GE, 100GE and SONET/SDH satellite variants, offering 24/48xGE ports, 64xGE/10GE ports or legacy SONET/SDH ports over GE, 10GE and 100GE uplinks
- OAM: Extensive fault and performance operations, administration and maintenance (OAM) includes Ethernet Connectivity Fault Management (CFM) (IEEE 802.1ag, ITU-T Y.1731), Ethernet in the First Mile (EFM) (IEEE 802.3ah), Bi-Directional Fault Detection (BFD), Cflowd, Two-Way Active Measurement Protocol (TWAMP), and a full suite of MPLS OAM tools, including GMPLS UNI
- Timing: ITU-T Synchronous Ethernet (SyncE), IEEE 1588v2, Network Time Protocol (NTP), BITS ports (T1, E1, 2M), and 1PPS
- QoS: Flexible intelligent packet classification; ingress and egress hierarchical QoS with multitiered shaping and two-tiered, class fair hierarchical policing; advanced, scalable network and service QoS, and end-to-end consistent QoS regardless of oversubscription or congestion
- High availability: Nonstop routing, nonstop services, ISSU, fast reroute for IP, RSVP, LDP and segment routing, pseudowire redundancy, ITU-T G.8031 and G.8032, weighted ECMP, and weighted, mixed-speed link aggregation

## Management features

- Model-driven network element management through CLI, NETCONF and gRPC/gNMI using YANG models
- Full SNMP management support, including configuration
- Comprehensive network and node management through the Nokia NSP



Please refer to the Nokia 7950 XRS data sheet and product information for full system details on safety standards, compliance, agency certifications and protocol support.

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